

What is claimed is:

1. A reactor suitable for mixing and reacting a fuel and an oxidant, comprising:
a reactor body having a longitudinal axis;
an inlet chamber connected to said reactor body and having a central axis aligned with the longitudinal axis of said reactor body; and
a mixing section connected to said inlet chamber and having a central axis at an angle to the longitudinal axis of said inlet chamber; wherein said mixing section comprises:
an oxidant inlet adapted to inject a stream of oxidant into said mixing section; and
a fuel inlet adapted to inject a stream of fuel into said mixing section such that the stream of fuel flows tangentially to the stream of oxidant and mixes with said oxidant stream to form a reactant stream.
2. The reactor of claim 1 wherein the angle between the central axis of the mixing section and the longitudinal axis of the inlet chamber is less than 90°.
3. The reactor of claim 1 wherein the angle between the central axis of the mixing section and the longitudinal axis of the inlet chamber is between 30° and 60°.
4. The reactor of claim 1 further comprising a mixing device disposed within said mixing chamber.
5. The reactor of claim 4 wherein said mixing device comprises one or more spiral members.

6. The reactor of claim 1 further comprising a pressure relief device connected to said inlet chamber and in fluid communication with said reactor body.
7. The reactor of claim 6 wherein said pressure relief device has a central axis aligned with the longitudinal axis of said reactor body.
8. The reactor of claim 6 wherein said inlet chamber has a lower end connected to said reactor body and an upper end connected to said pressure relief device.
9. A mixing device for supplying a mixture of a fuel and an oxidant to a partial oxidation reactor, the device comprising:
 - a tubular reactor inlet chamber having a lower end connected to the reactor and an upper end having a pressure relief device;
 - a tubular mixing section connected to said reactor inlet chamber at a reactant gas inlet, wherein the longitudinal axis of said mixing section is at an angle to the longitudinal axis of said inlet chamber;
 - an axial inlet adapted to inject the oxidant into said mixing section along the longitudinal axis of said mixing section; and
 - a fuel inlet adapted to inject the fuel into an annular area between the oxidant and the inside of the tubular mixing section.

10. The mixing device of claim 9 wherein said fuel inlet injects the fuel tangentially to the axial inlet.
11. The mixing device of claim 9 wherein said fuel inlet injects the fuel parallel to the axial inlet.
12. The mixing device of claim 9 wherein the angle between the longitudinal axis of the mixing section and the longitudinal axis of the inlet chamber is less than 90° .
13. The mixing device of claim 9 wherein the angle between the longitudinal axis of the mixing section and the longitudinal axis of the inlet chamber is between 30° and 60° .
14. The mixing device of claim 9 wherein said reactor inlet chamber is substantially free of obstructions between the lower end and the upper end.
15. The mixing device of claim 9 further comprising a flow conditioner disposed within said mixing section between the reactant gas inlet of said inlet section and said axial inlet.
16. The mixing device of claim 15 wherein said flow conditioner further comprises a permeable mixing material comprising ceramic beads.
17. A process for making synthesis gas comprising:
injecting an oxidant along the longitudinal axis of a mixing section;

injecting a fuel tangentially along the inside of the mixing section so that the fuel mixes with the oxidant to form a reactant gas;

injecting the reactant gas into a reactor inlet chamber at an angle to the longitudinal axis of the inlet chamber; and;

feeding the reactant gas into a synthesis gas reactor; and

converting at least a portion of said reactant gas to a gas comprising hydrogen and carbon monoxide.

18. The process of claim 17 wherein the synthesis gas reactor comprises a catalyst.
19. The process of claim 17 wherein the oxidant comprises molecular oxygen.
20. The process of claim 17 wherein the fuel comprises methane or natural gas.
21. The process of claim 17 further comprising converting at least a portion of said gas comprising hydrogen and carbon monoxide to a product selected from the group comprising: synthetic fuels methanol, olefins, and combinations thereof.